

Grassland, Desert, and Tundra Biomes

In areas with too little precipitation or too many fires for large trees or shrubs to survive, smaller plants dominate biomes. Where there is almost no rainfall at all, few plants can grow and we find desert. Thus, warm areas with little precipitation are characterized by savanna and desert biomes. Temperate areas have grassland, chaparral, and desert biomes. Fire can play an important role in determining what biome is found in warm regions. Cold areas have tundra and desert biomes.

Savannas and Tropical Seasonal Forests

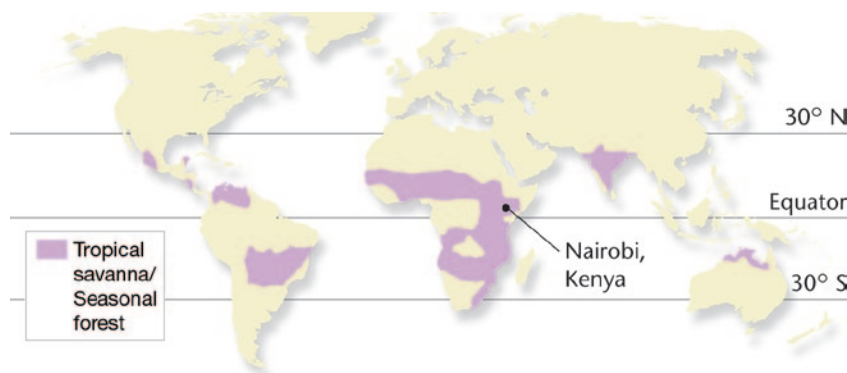
Parts of Africa, India, Australia, and South America are covered by grasslands called savanna. A **savanna** is a tropical biome dominated by grasses, shrubs, and small trees. *Tropical seasonal forests* have larger growths of trees. Compared to savannas, tropical seasonal forests have slightly wetter conditions and less frequent fires. As **Figure 3.1** shows, rain falls mainly during the wet season, which lasts for only a few months of the year. This is the only time that plants can grow. African savannas support an amazing variety of herbivores, such as antelopes, giraffes, and elephants, as well as the predators that hunt them, such as cheetahs, lions, and hyenas.

Plants of the Savanna and Tropical Seasonal Forests

Because most of the rain falls during the wet season, plants must be able to survive long periods of time without water. In the dry season, plants lose their leaves or die back. When the rain returns, they start to grow again. Many plants have large, horizontal root systems so they can draw water from as large an area as possible. The coarse savanna grasses have vertical leaves that expose less of their surface area to the hot sun to further help the grasses conserve water. Trees and shrubs often have thorns or sharp leaves that keep hungry herbivores away.

FIGURE 3.1

Tropical Savanna and Seasonal Forests Wet and dry seasons characterize this biome.



SECTION 3

Objectives

- ▶ Describe the difference between tropical and temperate grasslands.
- ▶ Describe the climate in a chaparral biome.
- ▶ Describe two desert animals and the adaptations that help them survive.
- ▶ Describe one threat to the tundra biome.

Key Terms

savanna
temperate grassland
chaparral
desert
tundra
permafrost

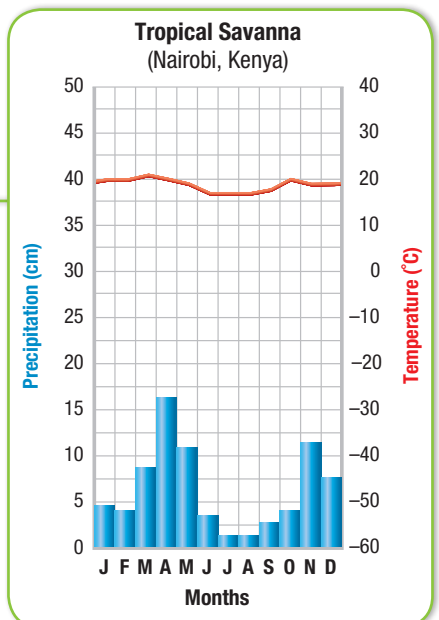


FIGURE 3.2

Migratory Animals Herbivores of the savanna, such as the elephants shown here, range widely in search of food.



Animals of the Savanna

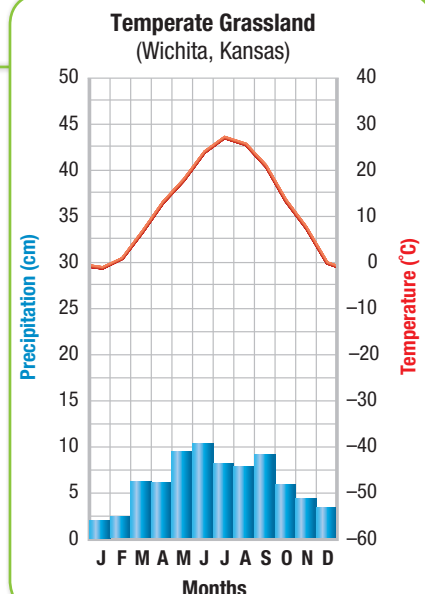
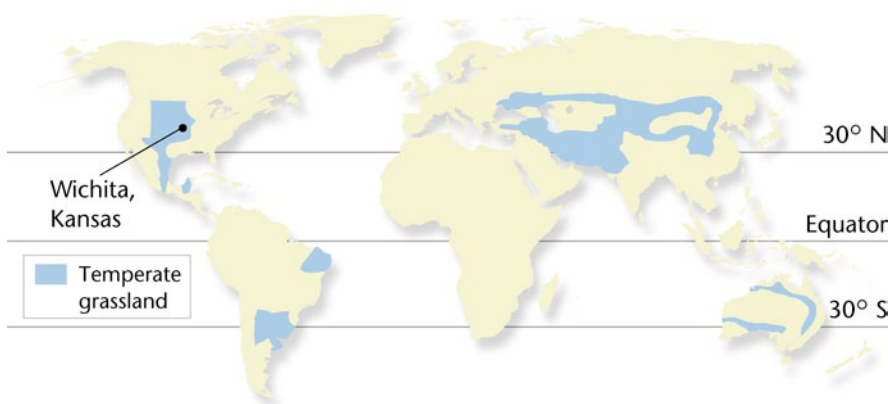
Grazing herbivores, such as the elephants shown in **Figure 3.2**, have adopted a migratory way of life. They follow the rains to areas of newly sprouted grass and watering holes. Some predators follow and stalk migratory animals for food. Many savanna animals give birth only during the rainy season, when food is most abundant and the young are more likely to survive. Also, some species of herbivores eat vegetation at different heights than do other species. For example, small gazelles graze on grasses, black rhinos browse on shrubs, and giraffes feed on tree leaves.

Temperate Grasslands

Temperate grassland covers large areas of the interior of continents, where there is moderate rainfall but trees and shrubs cannot be established because there is not enough rain or fires are too frequent. The prairies in North America, the steppes in Asia, the veldt in South Africa, and the pampas in South America are temperate grasslands. Their locations are shown in **Figure 3.3**.

FIGURE 3.3

Temperate Grassland Small amounts of rainfall, periodic droughts, and high temperatures in the summer characterize this biome.



Mountains often play a crucial role in maintaining grasslands. For example, in North America, rain clouds moving from the west release most of their moisture as they pass over the Rocky Mountains. As a result, the shortgrass prairie just east of the Rockies receives so little rain that it looks almost like a desert. The amount of rain increases as you move east, which lets taller grasses and some shrubs grow. Grassland plants dry out in the summer, so lightning strikes often start fires. **Figure 3.4** shows two examples of temperate grasslands.

Plants of Temperate Grasslands

Temperate grassland vegetation consists of grasses and wildflowers. Although there is only a single layer of vegetation, many species may be present. Shrubs and trees grow only where the soil contains extra water, usually on the banks of streams.

Periodic fires are an important part of temperate grassland ecosystems. In fact, some plants have adapted to fire by producing fire-resistant seeds that need the fire's heat to begin the process of germination. The root systems of grassland plants form dense layers that survive drought and fire. **Figure 3.5** shows how the heights of grasses and the depths of their roots vary.

Grasslands are highly productive because of their fertile soil. The summer is hot and the winter is cold, so the plants die back to their roots in the winter. Low temperatures in the winter slow decomposition. As a result, the rate at which dead plants decay is slower than the rate at which new vegetation is added each year. Over time, organic matter accumulates in the soil. This means that grasslands have the most fertile soil in the world. Most grasslands have been converted to farmland for growing crops such as wheat and corn.

FIGURE 3.4

Grasses The steppes in Asia (top) and the pampas in South America (bottom) are dominated by grasses and other plants that are adapted to temperate grasslands.

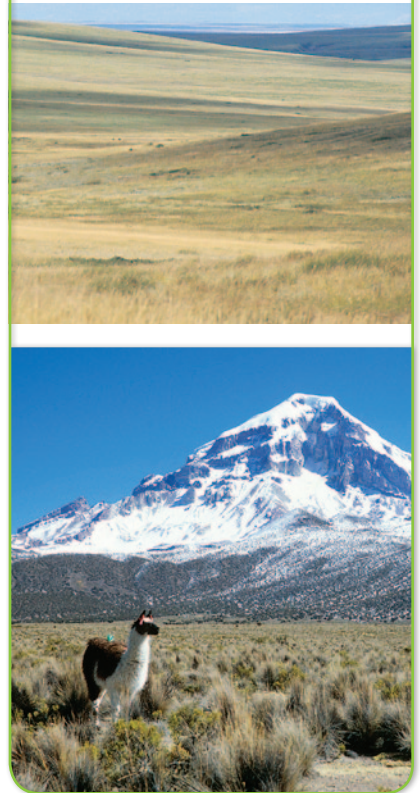


FIGURE 3.5

Grass Height and Root Depth The height of grassland plants and the depth of their roots depend on the amount of rainfall that the grasslands receive.



CRITICAL THINKING

Apply What would you expect the root length to be for a plant that grows in a prairie that receives 20 cm of precipitation annually?

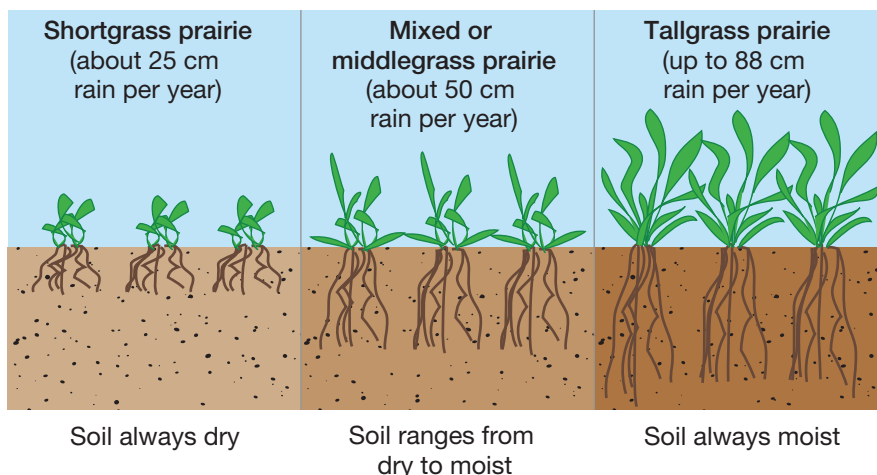
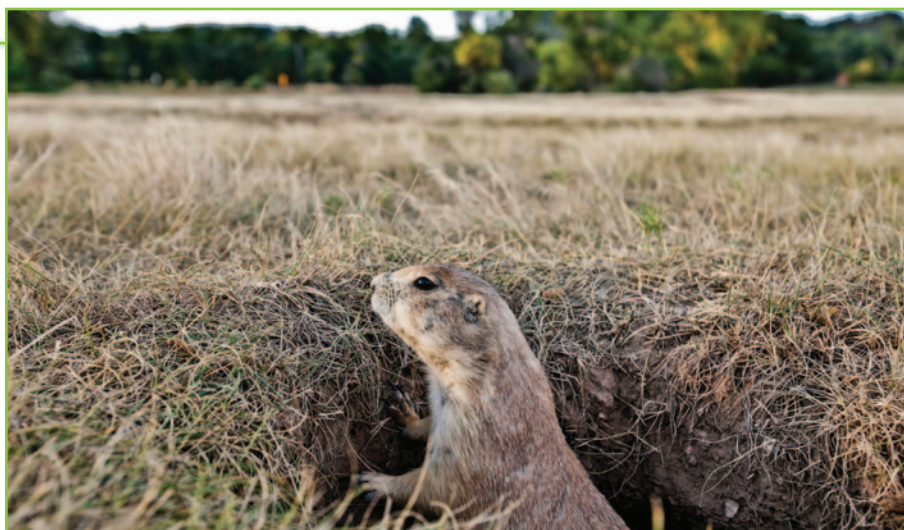


FIGURE 3.6

Underground Burrows Prairie dogs, such as the one shown here, live in temperate grasslands. Prairie dogs live in colonies and burrow in the ground to build mounds, holes, and tunnels.



QUICKLAB

Plant Adaptations

Procedure

1. Working in a small group, use a hand lens or binocular microscope to closely examine the leaves, stems, and roots of various plants provided by your teacher.
2. Based on the characteristics of the plants and the descriptions of the biomes given in the text, predict what type of biome each plant comes from.
3. Construct a data table where you can record each plant name, a description of its physical characteristics, and your biome predictions for each.

Analysis

1. What common characteristic did you observe in the plants from dry climates and those from cold climates? Why do you think the plants from two very different climates share this characteristic?
2. Choose a characteristic you observed in one particular plant and explain how that adaptation might help the plant to better survive in its biome.

Animals of Temperate Grasslands

Grazing animals, such as pronghorn and bison, have large, flat back teeth for chewing the coarse prairie grasses. Other grassland animals, such as badgers, prairie dogs, and burrowing owls, live protected in underground burrows as shown in **Figure 3.6**. The burrows shield the animals from fire and weather and protect them from predators.

Threats to Temperate Grasslands

Farming and overgrazing have changed the grasslands. Grain crops cannot hold the soil in place as well as native grasses can because the roots of crops are shallow and the soil is ploughed regularly, so soil erosion eventually occurs. Erosion is also caused by overgrazing. When grasses are constantly eaten and trampled, the grasses cannot regenerate or hold the soil. This constant use can change fruitful grasslands into less productive, desertlike biomes. The Dust Bowl era, which affected the Great Plains in the 1930s, is a dramatic example of what can happen when temperate grasslands are converted to agricultural land and improperly managed.

Chaparral

Temperate woodland biomes have fairly dry climates but receive enough rainfall, or mists from the ocean, to support more plants than do deserts. One type of temperate woodlands consists of scattered tree communities made up of coniferous trees such as piñon pines and junipers.

The **chaparral** is a temperate shrubland biome that is found in all parts of the world with a Mediterranean climate. These areas have moderately dry, coastal climates, with little or no rain in the summer. Look at the famous white letters that spell Hollywood across the California hills in **Figure 3.7**. Now imagine the scrub-covered settings common in old west-erns. Both of these landscapes are part of the chaparral biome. As shown in **Figure 3.8**, chaparral is located in the middle latitudes, about 30° north and south of the equator.

FIGURE 3.7

Chaparral Plants The chaparral in the Hollywood hills is home to plants such as the manzanita, which is shown at right.



Plants of the Chaparral

Most chaparral plants are low-lying evergreen shrubs and small trees that tend to grow in dense patches. Common chaparral plants include chamise, manzanita, scrub oak, olive trees, and herbs, such as bay laurel. These plants have small, leathery leaves that retain water. The leaves also contain oils that promote burning, which is an advantage because natural fires destroy trees that might compete with chaparral plants for light and space. Chaparral plants are so well adapted to fire that they can resprout from small bits of surviving plant tissue.

Animals of the Chaparral

A common adaptation of chaparral animals is camouflage, which is shape or coloring that allows an animal to blend into its environment. Animals such as quail, lizards, chipmunks, and mule deer have a brownish-gray coloring that lets them move through the brush without being noticed.

Threats to the Chaparral

Worldwide, the greatest threat to chaparral is human development. Because chaparral biomes get a lot of sun, are near the oceans, and have a mild climate year-round, humans tend to develop the land for commercial and residential use.

FIGURE 3.8

Chaparral A Mediterranean climate characterizes this biome.

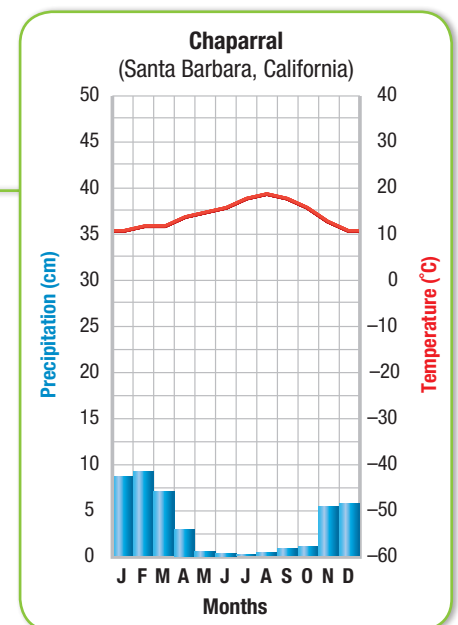
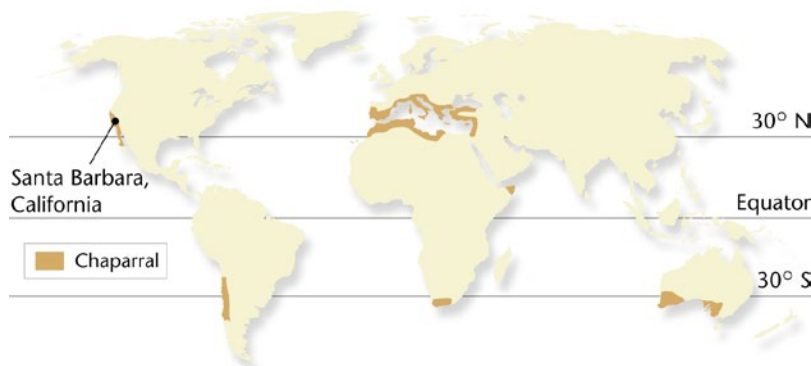
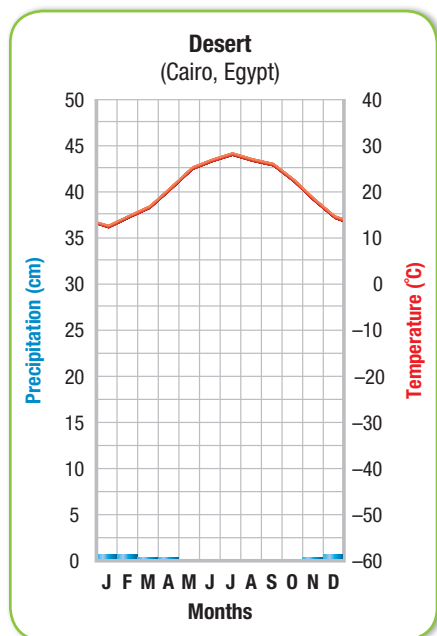


FIGURE 3.9

Desert A lack of precipitation characterizes this biome. Deserts typically receive less than 25 cm of precipitation a year.



Deserts

When some people think of a desert, they think of the hot sand that surrounds the Egyptian pyramids. Other people picture the Sonoran Desert and its mighty saguaro cactuses, or the magnificent rock formations of Monument Valley in Arizona and Utah. Many kinds of deserts are located throughout the world, but one characteristic that they share is that they are among the driest places on Earth.

Deserts are areas that have widely scattered vegetation and receive very little rain. In extreme cases, it never rains and there is no vegetation. The distribution of Earth's deserts is shown in **Figure 3.9**. Even in hot deserts near the equator, there is so little insulating moisture in the air that the temperature changes rapidly during a 24-hour period. The temperature may go from 40°C (104°F) during the day to near-freezing at night. Deserts are often located near mountain ranges, which block the passage of rain clouds.

Plants of the Desert

All desert plants have adaptations for obtaining and conserving water, which allow the plants to live in dry, desert conditions. Plants called *succulents*, such as cactuses, have thick, fleshy stems and modified leaves called spines that store water. Their spines also have a waxy coating that prevents water loss. Sharp spines on cactuses keep thirsty animals from devouring the plant's juicy flesh. Rainfall rarely penetrates deeply into the soil, so many plants' roots spread out just under the surface of the soil to absorb as much rain as possible.

Many desert shrubs drop their leaves during dry periods and grow new leaves when it rains again. When conditions are too dry, some plants die and drop seeds that stay dormant in the soil until the next rainfall. Then, new plants quickly germinate, grow, and bloom before the soil becomes dry again. Some desert plants have adapted so that they can survive even if their water content drops to as low as 30 percent of their mass. Water levels below 50 to 75 percent are fatal for most plants.



FIELDSTUDY

Go to Appendix B to find the field study **Xeriscaping**.

FIGURE 3.10

Desert Adaptations Desert plants survive harsh conditions by having specialized structures that limit the loss of water. Desert animals bury themselves underground or burrow in cactuses to avoid extreme temperatures and predators.



Elf owls burrow in cactuses to avoid hot temperatures during the day.

The Sonoran Desert in Arizona appears lush with plant life just after the winter rains.



The flapnecked chameleon lives in the deserts of Namibia.



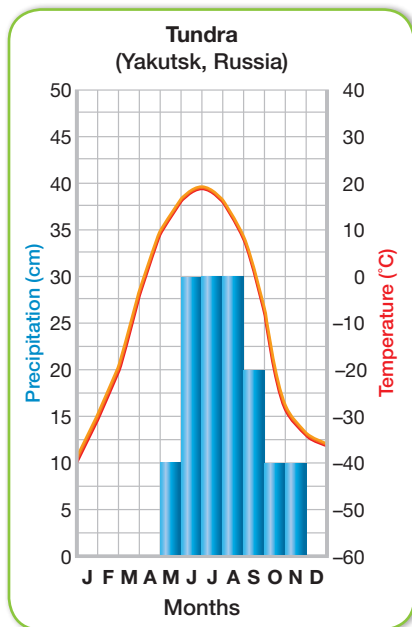
This sidewinder has a unique way of moving so that only small portions of its body are in contact with the hot sands at any one time.

Animals of the Desert

Reptiles, such as Gila monsters and rattlesnakes, have thick, scaly skin that prevents water loss. Amphibians, such as the spadefoot toad, survive scorching desert summers by *estivating*—burying themselves in the ground and sleeping through the dry season. Some animals, such as the elf owl shown in **Figure 3.10**, nest in cactuses to avoid predators. Desert insects and spiders are covered with body armor that helps them retain water. In addition, most desert animals are nocturnal, which means they are active mainly at night or at dusk, when the air is cooler.

FIGURE 3.11

Tundra The precipitation that the tundra biome receives remains frozen much of the year.



Tundra

The **tundra** biome is located in northern arctic regions, as shown in **Figure 3.11**. The winter is too cold and dry to permit the growth of trees in this biome. In many areas of the tundra, the deeper layers of soil, called **permafrost**, are permanently frozen throughout the year. As a result, the topsoil is very thin. In the summer, when the thin topsoil layer thaws, the tundra landscape becomes quite moist and spongy and is dotted with bogs. These wet areas are ideal breeding grounds for enormous numbers of swarming insects, such as mosquitoes and black flies, and for the many birds that feed on the insects.

Vegetation of the Tundra

Over 400 species of wildflowers, such as the fireweed shown in **Figure 3.12**, grow in the tundra during the summer. Mosses and lichens, which can grow without soil, cover vast areas of rocks in this biome. The soil is thin, so plants have wide, shallow roots to help anchor them against the icy winds. Most flowering plants of the tundra, such as campion and gentian, are short. Growing close to the ground keeps the plants out of the wind and helps them absorb heat from the sunlit soil during the brief summer. Woody plants and perennials such as willow and birch have evolved dwarf forms and grow flat or grow along the ground.

FIGURE 3.12

Short Growing Season During its brief summer, the Alaskan tundra is covered by flowering plants and lichens.



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FIGURE 3.13

Breeding Grounds Many migratory animals, such as snow geese (left) and caribou (right), return to the tundra each year to breed.



Animals of the Tundra

Millions of migratory birds fly to the tundra to breed in the summer. Food is abundant in the form of plants, mollusks, worms, and especially insects. Caribou, shown in **Figure 3.13**, migrate throughout the tundra in search of food and water. Wolves roam the tundra and prey on caribou, moose, and smaller animals, such as lemmings, mice, and hares. These animals burrow underground during the winter but they are still active. Many animals that live in the tundra year-round, such as arctic foxes, lose their brown fur and grow white fur that camouflages them with the winter snow. These animals are also extremely well insulated.

Threats to the Tundra

The tundra is one of the most fragile biomes on the planet. Its food webs are relatively simple, so they are easily disrupted. Because conditions are so extreme, the land is easily damaged and slow to recover. Until recently, the tundra was undisturbed by humans. But oil has been located in some tundra regions, such as in northern Alaska. Oil exploration, extraction, and transport can disrupt the habitats of the plants and animals in many parts of the tundra. Global climate change is the most widespread threat to tundra, partly because the largest warming trends are in the arctic region. Warming lowers the level of permafrost, promoting the growth of shrubs and small trees.

Connect to MATH

U.S. Oil Production

On average, the United States produces an estimated 8.1 million barrels of oil per day. How many millions of barrels of oil does the United States produce in 1 year? If all of the oil-producing countries of the world produce an estimated 74.13 million barrels of oil per day, what percentage of worldwide oil does the United States produce?

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Section 3 Formative Assessment

▶ Reviewing Main Ideas

1. **Describe** two desert animals and the adaptations that help them survive.
2. **Describe** how savannas differ from temperate grasslands.
3. **Compare** the plants that live in deserts with the plants that live in the tundra biome.
4. **Describe** one threat to the tundra biome.

✔ Critical Thinking

5. **Making Inferences** Former grasslands are among the most productive farming regions. Read the description of temperate grasslands in this section and explain why this statement is true.
6. **Analyzing Relationships** Explain why elephants and caribou, which live in very different biomes, both migrate.